



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH (CSE-NEW/IT-NEW)/SEM-4/CS-402/2013

2013

FORMAL LANGUAGE AND AUTOMATA THEORY

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

$$10 \times 1 = 10$$

- i) Which is true of the following ?
 - a) Merger graph is directed graph
 - b) Compatible graph is directed graph
 - c) Both are directed
 - d) None of these.
- ii) The logic of pumping lemma is a good example of
 - a) The pigeon-hole principle
 - b) The divide and conquer technique
 - c) Recursion
 - d) Iteration.



iii) $a^*(a + b)^*$ is equivalent to

- a) $a^* + b^*$ b) a^*b^*
 c) $(ab)^*$ d) none of these.

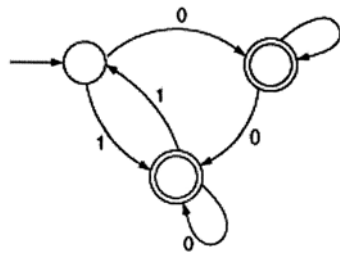
iv) The class of context free language is not closed under

- a) Concatenation
 b) Union
 c) Intersection
 d) Repeated Concatenation.

v) Which of the following strings can be obtained by the language $L = \{a^i b^{2i} \mid i \geq 1\}$

- a) aaabbbbbbb b) aabbb
 c) abbabbba d) aaaabbbabb.

vi) Which string is not accepted by the following FSA ?



- a) 00111 b) 00110
 c) 01010 d) 11010.



vii) Which of the following production is in CNF ?

- a) $S \rightarrow aA$ b) $SA \rightarrow AS$
- c) $S \rightarrow AB$ d) All of these.

viii) The solution to the equation $R = Q + RP$ is

- a) $R = QP^*$ b) $R = Q^*P$
- c) $P = RQ^*$ d) $R = P$.

ix) A shift register is

- a) Mealy M/C
- b) Turing M/C
- c) Moore M/C
- d) all of these.

x) Consider the following language :

$$L = \{a^n b^n c^n d^n \mid n \geq 1\}$$

L is

- a) CFL but not regular
- b) CSL but not CFL
- c) Regular
- d) Type 0 language but not type 1.

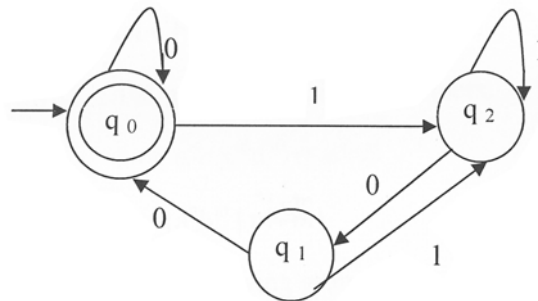


GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Design a Finite automate the accepts set of strings that every string ends with 00 over alphabet $\{0, 1\}$.
3. Let $\Sigma = \{a,b\}$, Prove that the Language $L = \{w \in \Sigma^* : n_a(w)\}$ is not regular.
4. Find the Context Free Grammar for the following language
 $L = \{ a^n b^2 n c^m : n, m \geq 0 \}$.
5. Construct the regular expression corresponding to the state diagram given below :



6. Design a Turing Machine that recognizes the language of all string of even length over the alphabet $\{a,b\}$.

**GROUP – C****(Long Answer Type Questions)**Answer any *three* of the following. $3 \times 15 = 45$

7. a) Construct a DFA from the NFA given below : 6

State/ Σ	I/P	
	0	1
$\rightarrow Q_0$	Q_0, Q_3	Q_0, Q_4
Q_3	Q_f
Q_4	Q_f
Q_f (Final State)	Q_f	Q_f

- b) Construct λ - NFA for the regular expression $(0 + 1)^* 1 (0 + 1)$ 4
- c) What is regular expression ? 2
- d) What will be regular expression over the alphabet $\{a, b\}$, for the language $L = \{a^n b^m : n \geq 4, m \leq 3\}$? 3
8. a) Design a TM that accepts $\{0^n 1^n \mid n \geq 1\}$ 5
- b) What do you mean by halting problem of a Turing machine ? 2
- c) Design a TM which can multiply two positive integers. 6
- d) Why a Turing machine is called linear bounded automation ? 2
9. a) State Myhill-Nerode theorem with the definition of equivalent relation and invariance. 3 + 2



- b) Minimize the following machine by applying Myhill-Nerode theorem. 10

PS	NS	
	X = a	X = b
→ A	B	E
B	C	D
Ⓒ	H	I
Ⓓ	I	H
E	F	G
Ⓕ	H	I
Ⓖ	H	I
H	H	H
I	I	I

10. a) Construct CFG for the following. 3 + 2 + 3

i) Palindrome for binary numbers.

ii) $L = \{ a^n b^n c^m d^m \mid m, n > 0 \}$

iii) $L = \{ a^n b^m \mid n \neq m \}$

- b) Convert the following grammar to CNF. 5

$S \rightarrow aA/B/C/a$

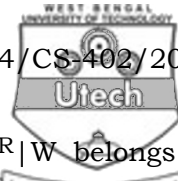
$A \rightarrow aB/E$

$B \rightarrow aA$

$C \rightarrow cCD$

$D \rightarrow abd$

- c) Define non-generating and non-reachable symbols with example. 2



11. a) Construct a PDA to accept $L = \{ WW^R \mid W \text{ belongs to } (a,b)^* \text{ and } W^R \text{ is reverse string of } W \}$ by empty stack and final state. 5

- b) Construct an equivalent PDA for the following CFG.

$S \rightarrow aAB/bBA$

$A \rightarrow bS/a$

$B \rightarrow aS/b$

Show an ID for the string abbbaabbbab for the PDA generated with stack description. 7

- c) Explain Ogden's Lemma for CFL. 3

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